

Studies on the T cell response to pathogens: from statistical mechanics to elite controllers of HIV

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COMPLEX organisms, like humans, have an adaptive immune system that mounts pathogen-specific responses to diverse quickly evolving microbes for which the immune system is not pre-programmed. This flexible system can also go awry, and autoimmune diseases result from the adaptive immune system failing to discriminate between markers of self and non-self. Adaptive immune responses are orchestrated by T lymphocytes (T cells). The immune response involves cooperative dynamic processes with many participating components that must act collectively for a phenomenon to emerge. Moreover, these processes are stochastic and span multiple spatio-temporal scales. I will describe our work on T cell biology that brings together theoretical and computational studies (rooted in statistical physics) with experiments carried out by key collaborators (immunologists at medical schools) to shed light on the mechanisms underlying these complex multi-scale processes. I will begin by describing some work at the molecular scale, which will become the input to thinking about a phenomenon in tissues, which will then inform us about a factor that contributes to the ability of individuals with certain genes to neutralize HIV infections.